Prepared for the
ST. JOHNS RIVER WATER MANAGEMENT DISTRICT COOPERATIVE STUDY

GEOLOGIC CHARACTERIZATION OF LAKE KERR

MARION COUNTY, FLORIDA

By

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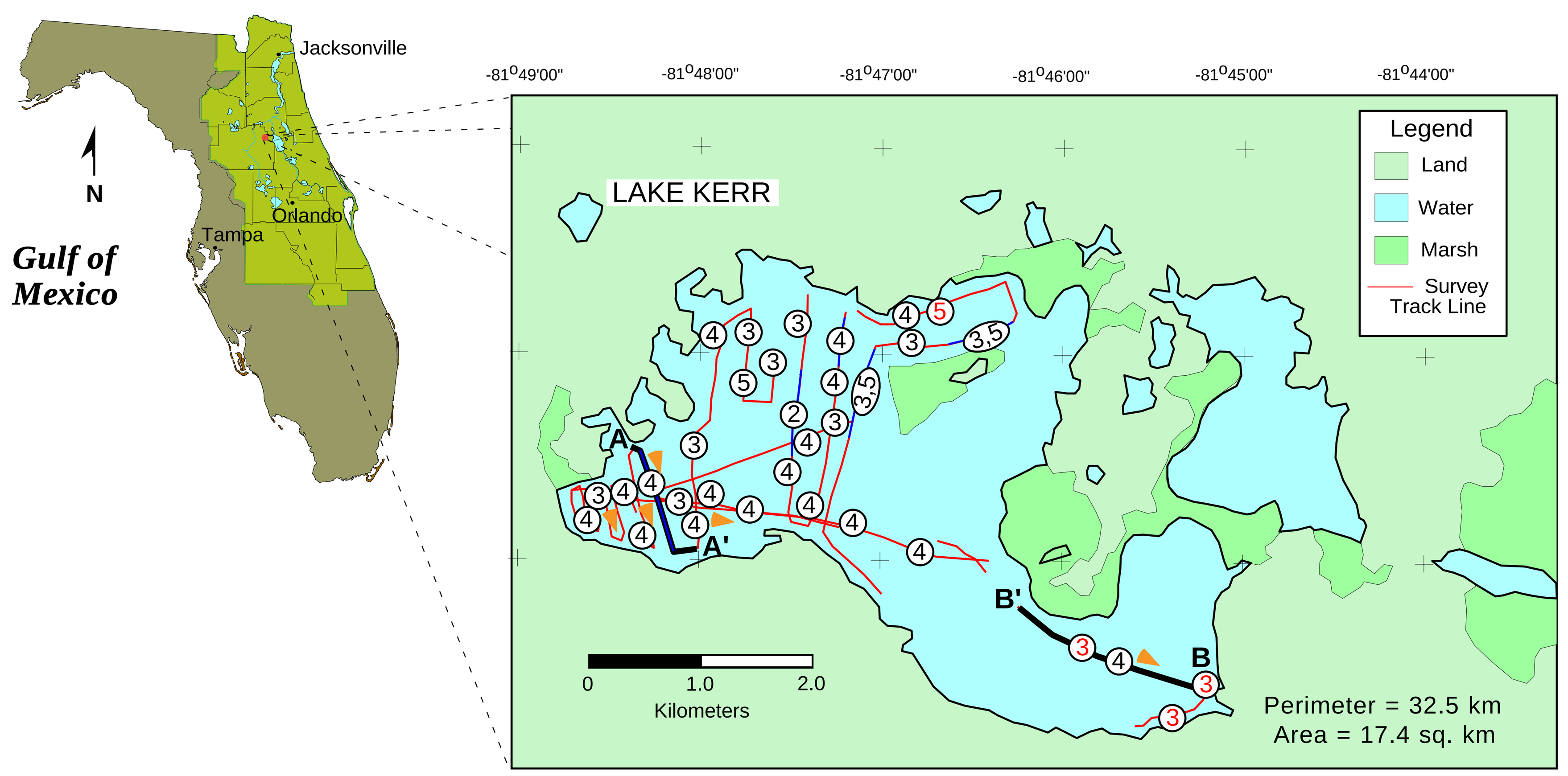
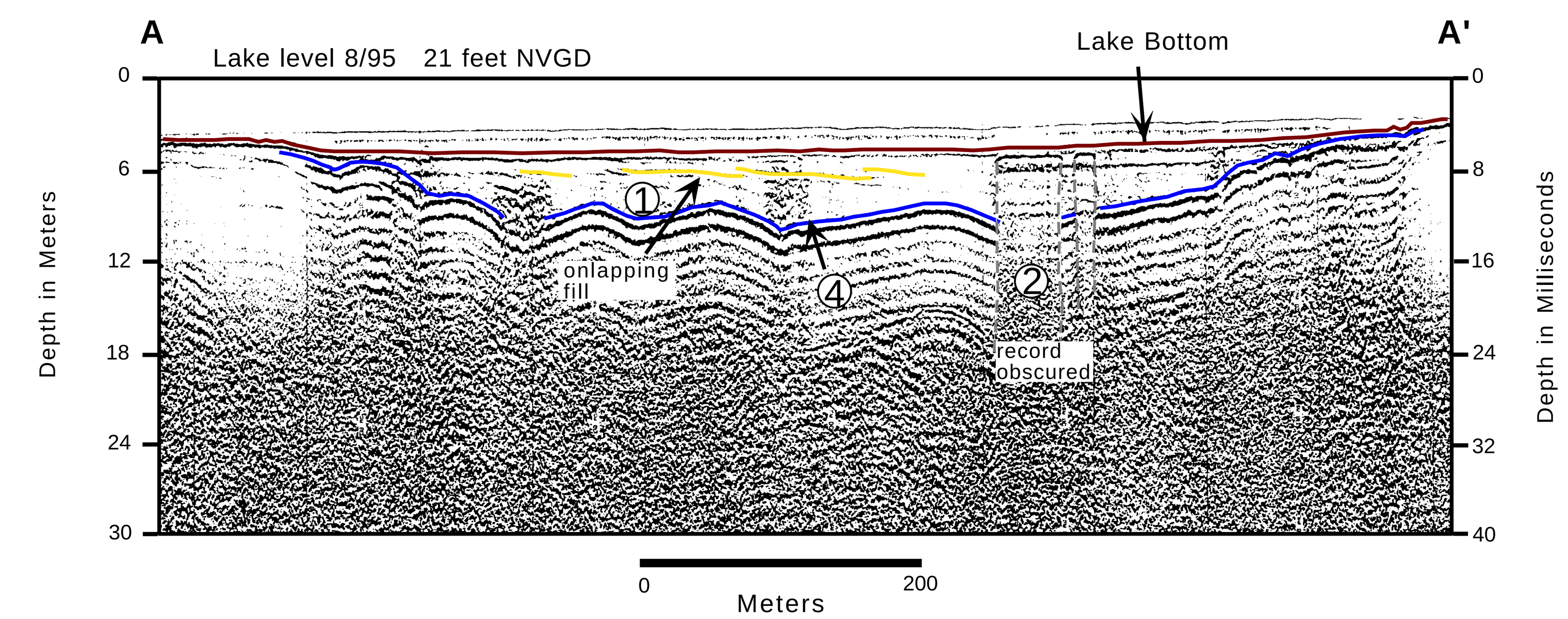
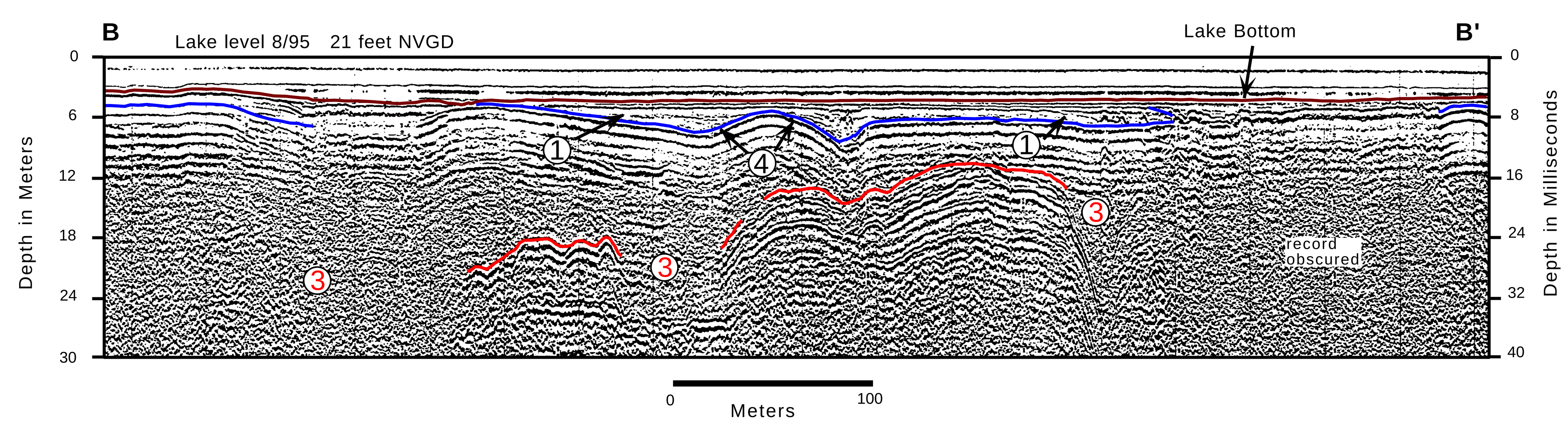
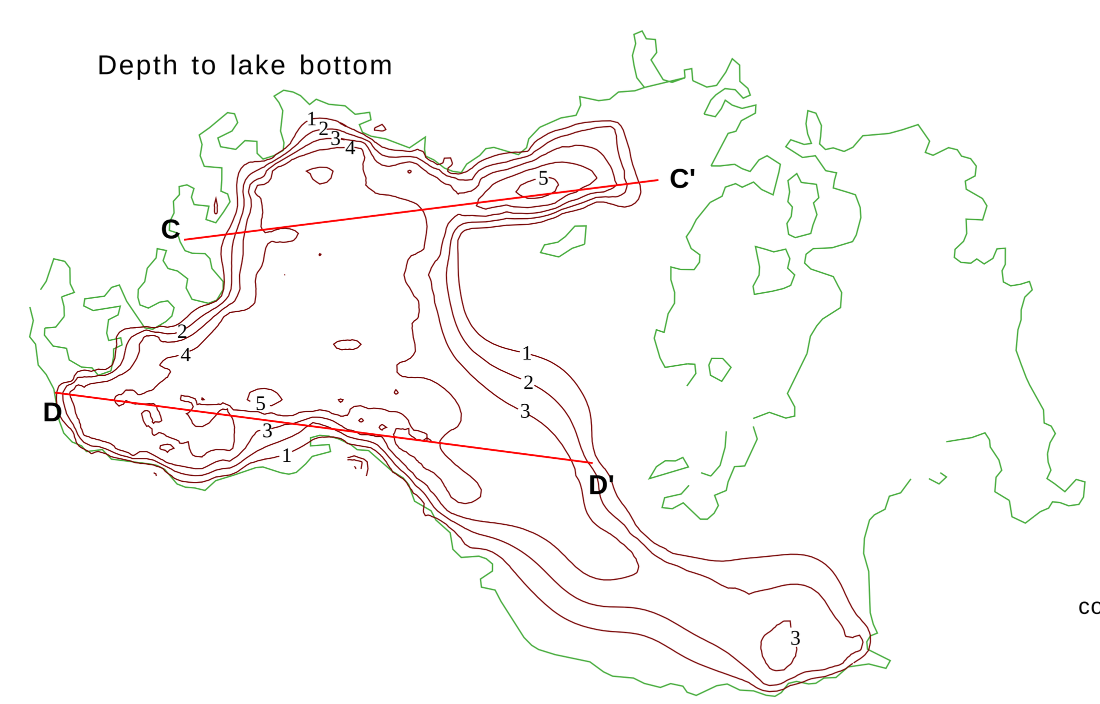
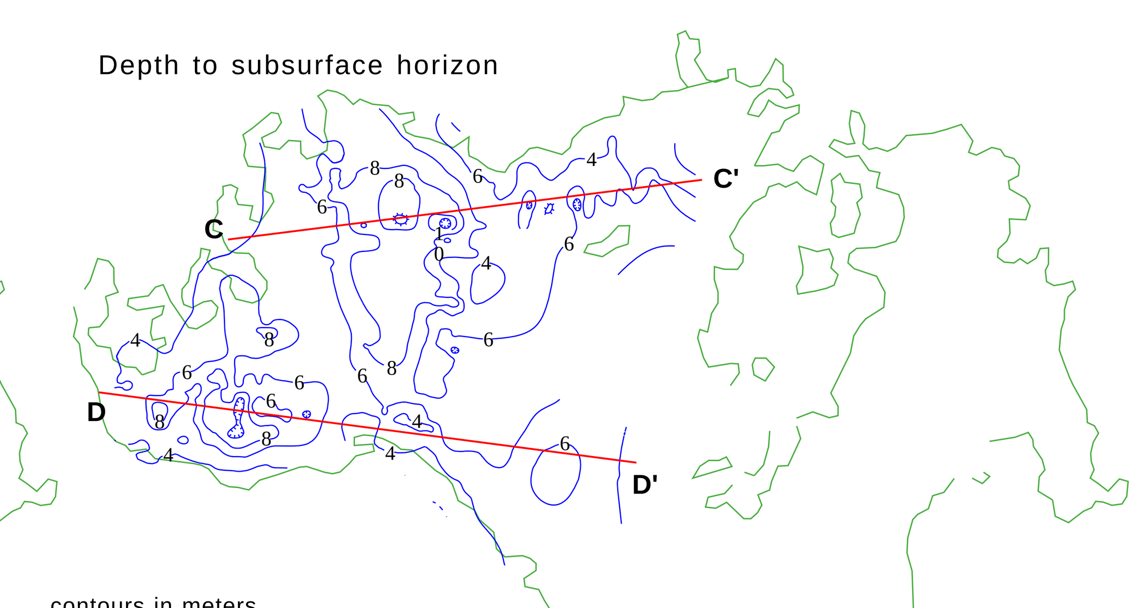


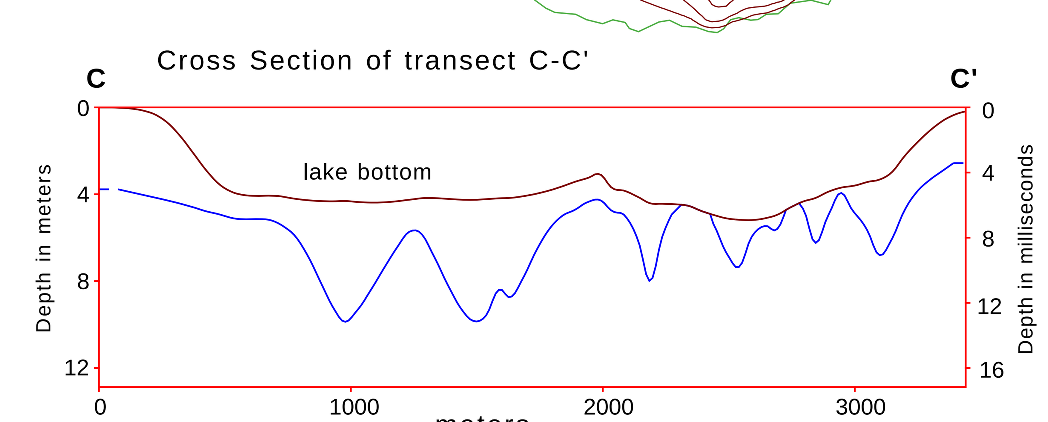
red number denotes feature visible in deeper reflective horizons, eastern side of lake only.
indicates apparent dip of fill in depressions (see text).

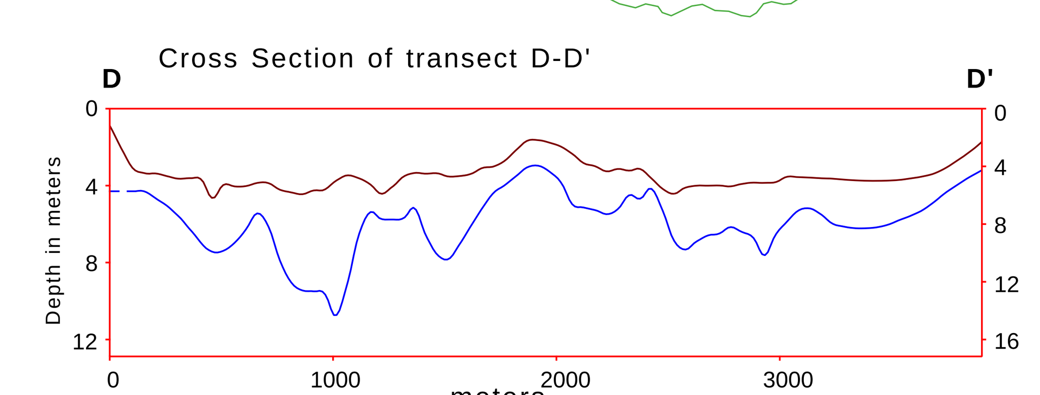












INTRODUCTION

The potential fliud exchange between lakes of northern Florida and the Floridan aquifer and the process by which exchange occurs is of critical concern to the St. Johns River Water Management District (SJRWMD). High-resolution seismic tools with relatively new digital technology were utilized in collecting geophysical data from > 40 lakes and rivers. The data collected shows the application of these techniques in understanding the formation of individual lakes and rivers, thus aiding in the management of these natural resources by identifying breaches or areas where the confining units are thin or absent between the water bodies, the Intermediate aquifer and the Floridian aquifer.

This study was a cooperative investigation conducted from 1993 to 1996 by the SJRWMD and U.S. Geological Survey Center for Coastal Geology (USGS). Since 1989 there have been technical and hardware advances in the digital acquisition of high-resolution seismic data. The primary objective of this cooperative was to test newly developed digital high-resolution single-channel marine seismic continuous-profiling-equipment (HRSP) and apply this technology to identify subbottom features that may enhance leakage from selected lakes and the St. Johns River. The target features include: (1) identifying evidence of breaches or discontinuities in the confining units between the water bodies and the aquifer, and; (2) identifying areas where the confining unit is thin or absent.

METHODS

In cooperation with SJRWMD the USGS acquired and upgraded a digital seismic acquisition system. The Elics Delph2 High-Resolution Seismic System was acquired with proprietary hardware and software running in real time on an Industrial Computer Corp. 486/33 PC. Hard-copy data was displayed on a gray scale thermal plotter. Digital data was stored on a rewritable Magneto-Optical compact disk. Navigation data was collected using a Trimble GPS or PLGR (Rockwell) GPS. GeoLink XDS mapping software was used to display navigation.

The acoustic source was the Huntec Model 4425 Seismic Source Module and a catamaran sled with an electromechanical device. Occasionally, an ORE Geopulse power supply was substituted for the Huntec Model 4425. Power was set at 60 joules or 135 joules depending upon conditions. An Innovative Transducers Inc. ST-5 multi-element hydrophone was used to detect the return acoustical pulse. This pulse was fed directly into the Elics Delph2 system for storage and processing.

Forty-four line-km of HRSP data was collected from Lake Disston. A velocity of 1500 meters per second (m/s) was used to calculate a depth scale for the seismic profiles. Measured site specific velocity data is not available for these sites.

These surveys were conducted in part to test the effectiveness of shallow-water marine geophysical techniques in the freshwater lakes of central Florida. Acquisition techniques were similar but modifications were necessary. Data quality varied from good to poor with different areas and varying conditions. As acquisition techniques improved so did data quality in general. In many areas an acoustic multiple masked much of the shallow geologic data.

PHYSIOGRAPHY

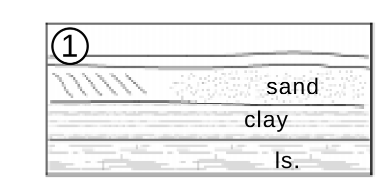
Lake Kerr, in northeast Marion county, is located in the Ocala Scrub area of the Central Lake District. The vast Ocala National Forest lies directly to the south. The shoreline is very irregular and nearly divides the lake in two, with a total length of 30 kilometers. The majority of the lake ranges between 2-4 meters (~6-14 feet) water depth, but exceeds 5 meters (~16 feet) in some areas. Salt Springs is located in the southeast portion of the lake and Salt Springs Run connects Lake Kerr to Lake George to the east and to the St. Johns River system.

GEOLOGIC CHARACTERIZATION

Lake Kerr is characterized by numerous subsidence depressions (Type 4) tens to hundreds of meters in width (seismic examples A-A', B-B'). Parallel to low angle reflectors within the depressions indicate active infilling during subsidence. The low angle reflectors appear to dip toward the southeast when present in the record (orange arrows, index map). This infilling gives the lake a smooth bathymetry (brown line contour map), unlike the highly irregular subsurface in which the subsidence occurs (blue line contour map). The reflective horizons that were digitized to produce the contour maps are shown on the seismic examples. The north and south cross sections, derived from the gridded contour data sets, shows this contrast very well and exemplify the highly eroded nature of karst substrata.

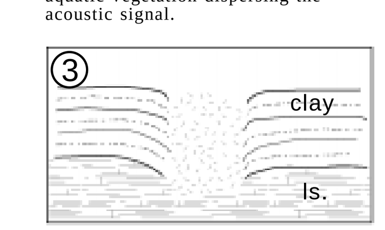
Noise in the seismic record decreases in the eastern part of the lake and deeper reflective horizons can be seen (seismic example B-B', red line). The acoustic signal in the lower horizons is more chaotic and contains very high angle reflectors, whereas the upper horizons have lower angle, intact reflectors. It seems apparent in the seismic profiles that more solution-type collapse has occured in the lower horizons and that it has influenced a more gradual subsidence in the overlying material (blue line). During subsidence the depressions were filled, possibly during migration of paleo-dunes that define this physiographic region.

EXPLANATION

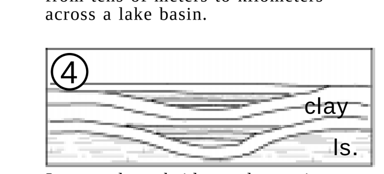


Undisturbed section, with or without upper non-reflective sand layer. Sand layer may show reflection where cross bedding from original deposition (fluvial or aeolian) exits. Clay layers are mostly intact.

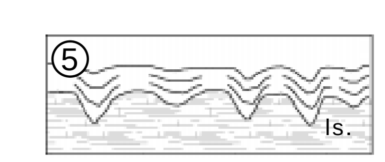
Undisturbed section with areas obscured by noise created by muck or aquatic vegetation dispersing the acoustic signal.



Horizontal reflectors continuous on either side of a central non-reflective zone. Horizontal layers bend downward towards the central zone. These features are representative of filled collapse sinks. The size may range from tens of meters to kilometers across a lake basin.



Low angle, subsidence depressions. Parallel reflectors are relatively intact. Horizontal reflectors onlap onto the subsided parallel reflectors and represent deposition during subsidence. These can be large basin size features or tens of feet.



Numerous small features with high angle reflectors dipping toward their center. These features may represent localized collapse sinks or filled solution pipes.